International Journal of Computer Networking,
Wireless and Mobile Communications (IJCNWMC)
ISSN(P): 2250-1568; ISSN(E): 2278-9448
Vol. 4, Issue 5, Oct 2014, 33-40

TRANS STELLAR • Journal Publications • Research Consultancy

PERFORMANCE ESTIMATION OF OFDM-WIMAX NETWORK

VISHAL SHARMA & NAVNEET KAUR

Department of electronics & Communication, Shaheed Bhagat Singh State Technical Campus, Ferozepur, India

ABSTRACT

In this paper, a demonstration of the performance estimation of OFDM-Wimax access network is carried out at varied values of subcarriers for uplink and downlink packet propagation and is followed by a comparison of performance of the reported OFDM-Wimax network. High performance of OFDM based Wimax network with acceptable SNR and BER is achieved by mitigating the fading problem of wireless network.

KEYWORDS: Wimax, OFDM, QoS

INTRODUCTION

With the rollout of the third generation cellular networks, the aim is already set towards the next generation. Future generation networks will be characterized by variable and high data rates, QoS services and seamless mobility both within a network and among different networks [1]. A technology developed to fulfil these characteristics is IEEE 802.16. Even though this IEEE standard is limited to the air interface, the network architecture is developed by the Wimax Forum, an interest group backed by technology companies such as Intel, Fujitsu, Samsung, AT&T and Alvarion. [2]. This architecture aims to apply high data rates, QoS, range and low deployment costs to a wireless access technology on a metropolitan scale. The original version of the standard on which Wimax is based (IEEE 802.16) specified a physical layer operating in the 10 to 66 GHz range. 802.16a is updated in 2004 to 802.16-2004, for 2 to 11 GHz range and further updated by 802.16e-2005 in 2005 and uses scalable orthogonal frequency-division multiple access (SOFDMA). Scaling of the Fast Fourier transform (FFT) is done to achieve the carrier spacing constant across different channel-bandwidths to achieve higher spectrum efficiency in wide-channels, and a cost reduction in narrow-channels.

As the allowed FFT sub-carriers are only 128, 512, 1024 and 2048, so other frequency bands do not have exactly the same carrier spacing, which might not be optimal for implementations. OFDM has developed into a popular scheme for wideband digital communication along with multiple antenna support through MIMO. This brings potential benefits in terms of coverage, self installation, power consumption, frequency re-use and bandwidth efficiency. There is no uniform global licensed spectrum for Wimax. However, the Wimax-Forum has published three licensed spectrum profiles: 2.3 GHz, 2.5 GHz and 3.5 GHz, in an effort to drive standardisation and decrease cost. In USA, the biggest segment available is around 2.5 GHz [3].

Some countries in Asia like India and Indonesia will use a mix of 2.5 GHz, 3.3 GHz and other frequencies. Wimax define channel size, TDD/FDD and other necessary attributes in order to have inter-operating products [4]. The current fixed profiles are defined for both TDD and FDD profiles At this point, all of the mobile profiles are TDD only. The fixed profiles have channel sizes of 3.5 MHz, 5 MHz, 7 MHz and 10 MHz. The mobile profiles are 5 MHz, 8.75 MHz and 10 MHz [5]. Many authors have worked on various QoS parameters like throughput, average jitter and average delay

impacting the Wimax service performance using different codec techniques. In this paper we have calculate more QoS parameters for downlink and uplink connections to realize OFDM-Wimax access network under the influence of different subcarriers.

MODEL DESCRIPTION

The demonstrated OFDM-Wimax network is designed using OPNET™ 14.5 consists of IPv4 enabled mobile nodes. In 1st scenario, the proposed access network is investigated using OFDM subcarriers of 512; similarly we used 1024 subcarriers in 2nd scenario and in 3rd scenario, we used 2048 OFDM subcarriers. In all the scenarios, the location of MS with Home Agent is set to BS_0. Bidirectional application traffic is configured between the MS and the server node in the backbone mapped to best Effort uplink/downlink connections of 64 kbps. The downlink traffic experiences more interruptions due to layer 3 handover delays via Mobile IPv4 and layer 2 handover delays are through Wimax MAC functionality [6]. The green circles correspond to areas around each BS where the SNR of an MS transmission to the BS drops below the scanning threshold of 27dB configured in the MS. Once the SNR drops below the scanning threshold, scanning activity is started to look forward to target other BSs for handover. The scanning activity ends, when the MS successfully changes its serving BS. After the MS attaches to the new serving BS, scanning still continues until the SNR at the MS receiver gets within a comfortable zone i.e. higher than the SNR threshold for scanning.

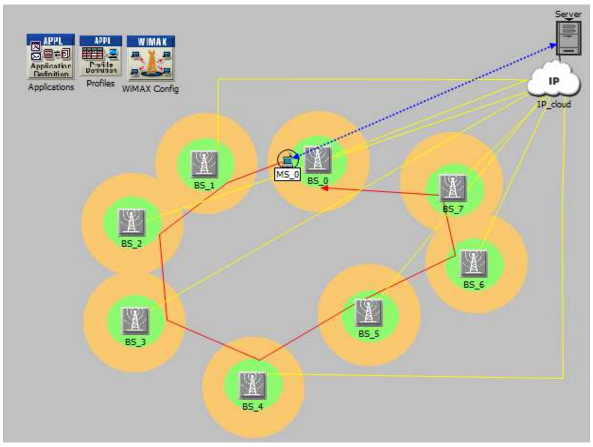

Figure 1: OFDM-Wimax Network Design

In order to achieve fair allocation of capacity to multiple users with different channel and traffic characteristics, we propose a subcarrier scheme in OFDMA. This is achieved by utilizing buffer state information and measured traffic statistics in addition to channel state feedback. The work is demonstrated by using 512, 1024, 2048 subcarriers. In OFDMA, sub channelization defines sub-channels that can be allocated to subcarriers stations depending on their channel conditions and data requirements. Several SS (Subscriber Station) can transmit in the same time slot over several sub-channels. Depending on the channel conditions and data requirements modulation and coding is set individually for each subscriber. Frame duration in simulation network is 5 msec [7].

The proposed OFDM-Wimax network is simulated for 1 hour at simulation speed of 162,850 events/second. RIP (Routing Information Protocol), a distance-vector routing protocol is employed to prevent routing loops by implementing a limit on the number of hops allowed in a path from the source to a destination. The maximum number of hops allowed for RIP is kept as 15. This hop limit, however, also limits the size of networks that RIP can support. A hop count of 16 is

considered as an infinite distance and used to deprecate inaccessible, inoperable/ undesirable routes. RIP implements the split horizon, route poisoning and hold down mechanisms to prevent incorrect routing information from being propagated. The proposed system is employed with TDD to separate outward and return signals and emulates full duplex communication over a half duplex communication link. The other simulated parameters for our proposed system are depicted in Table 1.

Table 1: Simulation Parameter

PARAMETER	VALUE
Simulator	Opnet
Channel Type	Wireless Channel
Simulation Time	1hr
Duplex Scheme	TDD
Routing Protocol	RIP
Frame Duration(msec)	5
Max.Transmission power (w)	2
OFDM Bandwidth (MHz)	5
Antenna Gain (db)	15
Min. Scanning Threshold(db)	27

RESULTS AND DISCUSSIONS

In this paper, we inspect the upshot of alteration in number of subcarriers on the performance of OFDM-Wimax network by executing three different scenarios. The performance of each of these scenarios is evaluated through QoS parameters such as average throughput, average delay, average jitter, and packet dropped, end to end delay and SNR. Wimax average delay is affected when the number of subcarriers gets tainted.

As the number of subcarriers gets augmented, the Wimax average delay gets decreased. It means with enlarging the number of subcarriers, the network performance gets improved.

With subcarriers of 512, Wimax delay reached to maximum value of 0.0195 (sec) after 5m of simulation time, then starts decreasing and attained its steady state values to 0.0188 (sec) after simulation time of 40 minutes. In second scenario of using 1024 subcarriers, Wimax average delay reached maximum to 0.0186 (sec) with minute variations after 20m of simulation time, then attained its steady state position after 40minutes of simulation. The same fashion is observed win third scenario with use of 2048 subcarriers and attains its steady state values at 0.0184 (sec) as shown in Figure 2.

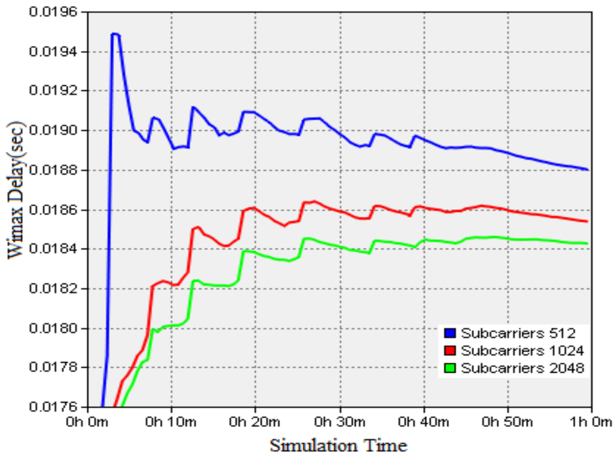

Figure 2: Average Delay of Wimax Network Using Different Number of OFDM-Subcarriers

Further, ETE delay is computed for both cases i.e. packet propagation from server to MS or MS to Server. It has been observed that as the number of OFDM-subcarriers increases ETE delay decreases for both the cases. When packet is travelling from MS to server i.e. case-I, ETE delay is computed as 0.0340(sec) for third scenario, as 0.0360(sec) for second- and first-scenario respectively initially. After simulation period of 25 minutes, all the scenarios attain the steady state values with minute variations. It has been observed that ETE delay attains its minimum value in first scenario in case-I. In case-II, all the scenarios attain the steady state values after simulation of 5 minutes and fixes to 0.0389 (sec).

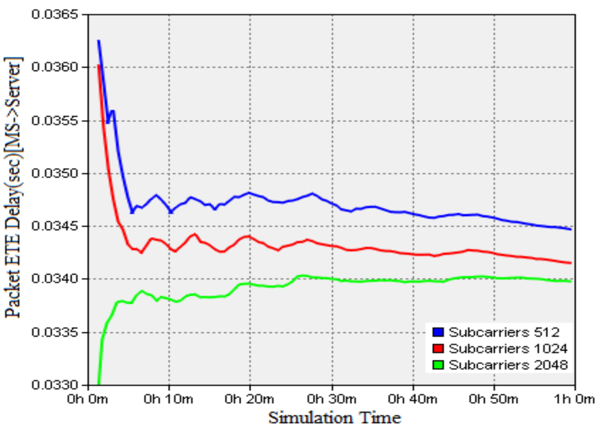

Figure 3: Average Packet ETE Delay (sec) [Mobile Station -> Server]

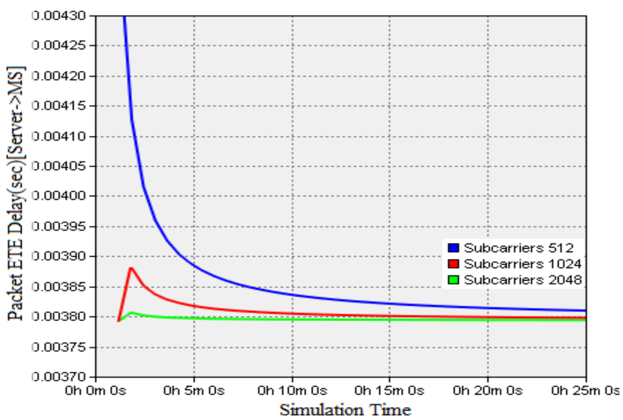

Figure 4: Average Packet ETE Delay (sec) [Server->Mobile Station]

Further, we have computed packet jittering for both the cases under the influence of number of OFDM-subcarriers. A decrease in packet jittering is observed with the increase in number of subcarriers.

In first case of MS to Server, the maximum average packet jitter is computed around 0.0092 sec initially and then reduces to 0.0080sec. For second scenario, the initially packet jittering is computed as 0.0065(sec) with OFDM-subcarriers of 2048 with minute variations and after 30 minutes of simulation time, it is stabilized to about 0.0070 sec.

For second scenario, the highest value of packet jittering is recorded initially to 0.0095sec which is arrive at its steady state position after simulation time of 10 minutes to 0.0075sec. For OFDM-subcarriers of 512, the highest value of packet jittering is recorded initially to 0.0095sec which is arrive at its steady state position after simulation time of 10 minutes to 0.0080 sec.

In second case i.e. packets propagation from server to MS, the packet jittering is maximum recorded initially for all simulated scenarios. The reported jittering decreases and approaches approximately to its steady state values as shown in Figure 6.

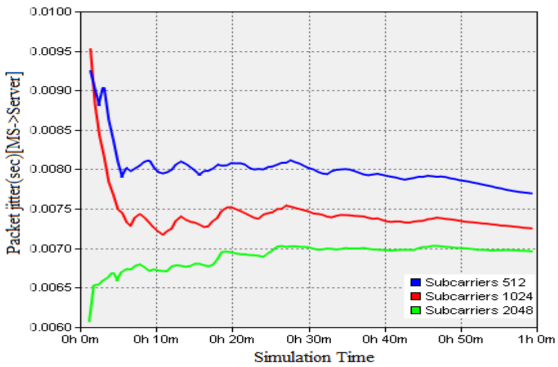

Figure 5: Average Packet Jitter (sec) [Mobile Station -> Server]

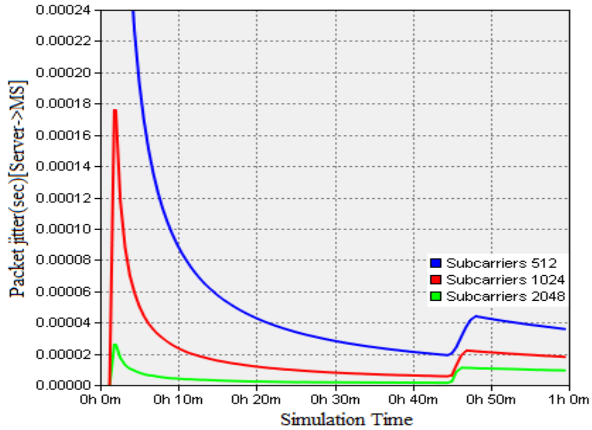

Figure 6: Average Packet Jitter (sec) [Server->Mobile Station]

Further, we have computed packet dropped for both the cases under the influence of number of OFDM-subcarriers. Initially, a sharp increase in packet dropped is recorded in all the scenarios in the first case of MS to Server. After simulation period of 10 minutes, a decrease in packed drop is reported. It is also observed that packed drop is least in

case of using OFDM-subcarriers of 512 as shown in Figure 7. In uplink direct, utmost packet drop rate is calculated in case of using OFDM-carriers of 512 as shown in Figure 8.

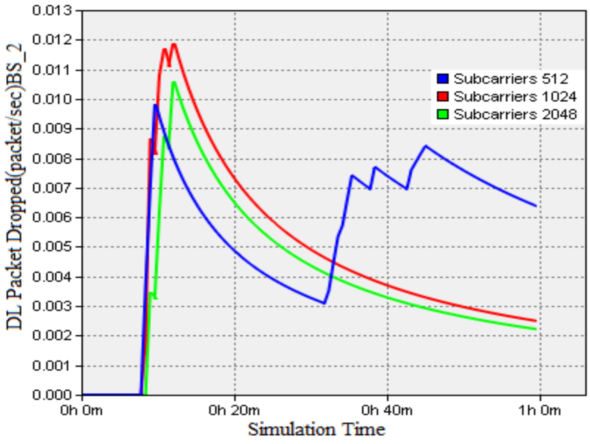

Figure 7: Downlink Packet Dropped (packet/sec)

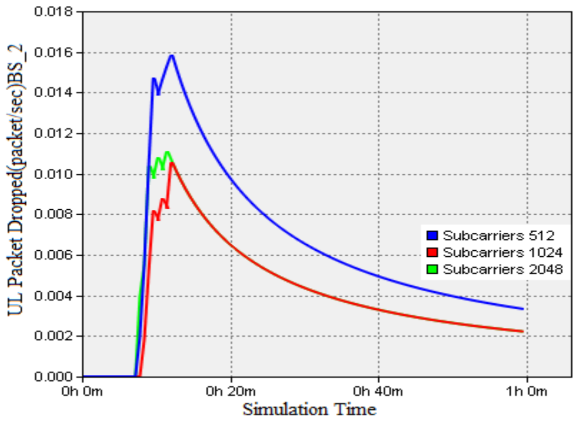

Figure 8: Uplink Packet Dropped (packet/sec)

Signal to noise ratio (SNR) is another dominating performance parameter of any wireless network that measures the acceptable BER of the network. So, we have evaluated SNR for downlink and uplink connections for all the simulated scenarios. In downlink direction with OFDM-subcarriers of 512, it is observed that as the downlink SNR ratio reaches to 30 dB initially and decreases to 14 dB after1 hr of simulation period. For second scenario, downlink SNR varies between 33.5 dB to 15 dB and for third scenario, SNR varies between 35 dB to 20 dB. For uplink data transmission over wireless medium, the evaluated SNR is in the comfortable zone of 16 dB to 22.5 dB as shown in Figure 10 for all the simulated scenarios but utmost with OFDM-subcarriers of 2048.

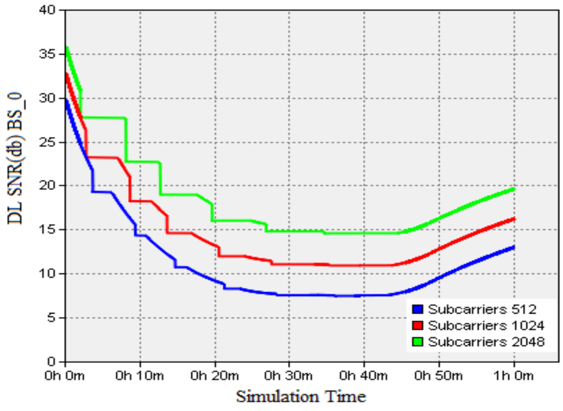

Figure 9: Downlink SNR (dB)

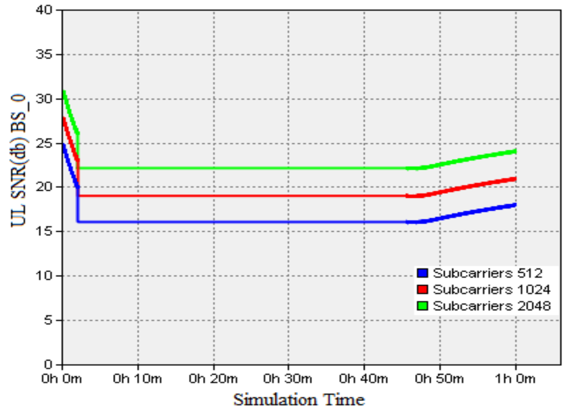

Figure 10: Uplink SNR (dB)

CONCLUSIONS

From our simulative results, we conclude that number of OFDM Subcarriers influence the QoS parameters significantly. Further, OFDM incorporated Wimax access network achieve acceptable uplink and downlink SNR as OFDM helps in reducing the fading problem in the Wimax network to prolong the coverage area with required QoS.

REFERENCES

1. P. Delannoy , H.D. Nguyen , M. Marot, N. Agoulmine , M. Becker "WiMax quality-of-service estimations and measurement." LRSM/IBISC Laboratory, University of Evry Val d'Essonne, 1 boulevard Francois Mitterrand, 91000 Evry, France ,CNRS SAMOVAR Laboratory, UMR 5157, Telecom Paris-Sud, France.
2. Analytical framework for dimensioning hierarchical WiMax–WiFi networksMarc Ibrahim , Kinda Khawam , Abed Ellatif Samhat ,*, Samir Tohme aa Universite de Versailles – Saint Quentin, Franceb France Telecom Research and Development Division, 9 Rue Charles Fourier, 91011 Evry cedex, France.
3. Alessandro Andreadis , Sandro Rizzuto, Riccardo Zambon"A WiMAX simulation module for investigating QoS during horizontalhandovers"University of Siena, Via Roma 56, 53100 Siena, Italy.

4. Qiang Ni, A. Vinel, Yang Xiao, A. Turlikov, Tao Jiang, Wireless broadBand access. WiMax and beyond investtigation of bandwidth request mechanismsunder point-to-multipoint mode of WiMax networks, CommunicationsMagazine, IEEE 45 (2007) .

5. Durantini, M. Petracca, Test of 2.5 GHz WiMAX performances for business and SOHO in a multi-service environment, in: IEEE 19th International Symposium on Personal, Indoor and Mobile Radio Communications, PIMRC2008, 2008, pp. 1

6. Hoymann, M. Dittrich, S. Goebbels, Dimensioning cellular multihop WiMAX networks, in: Mobile WiMax Symposium,Orlando, March 2007.

7. Franco, R. Rei, O. Cabral, F.J. Velez, Optimisation of enhanced UMTS cellular planning based economic aspects, in: WirelessTelecommunications Symposium, California, April 2006.

8. IEEE Standard for Local and Metropolitan Area Networks. Part 16: AirInterface for Fixed BroadBand Wireless Access Systems, IEEE 802.16-2009 Standard, May 2009.

9. D. Joshi, and S. Jangale, “Analysis of VoIP traffic in WiMAX using NS2 simulator” International Journal of Advanced Research in Computer Science and Electronics Engineering, Vol. 1, Issue 2, April 2012.

10. 3H. Abid, H. Raja, A. Munir, J. Amjad, A. Mazhar, D. Lee, “Performance Analysis of WiMAX Best Effort and ertPS Service Classes for Video Transmission”, ICCSA, Issue 3, pp. 368-375, 2012.